

Excerpts from Navy public documents regarding background

2005 Basewide Radiological Workplan:

8.1 REFERENCE (BACKGROUND) AREAS

An average background level will be determined by performing measurements at systematic or random locations within the designated background area. The detector probe will be held approximately 10 cm (4 inches) from the surface area for gamma and 0.25 inch from the surface area for alpha/beta radiation. Instrumentation will be allowed to stabilize before background readings are taken. The average of all of the readings taken will determine the background. Background scan ranges, smears, and exposure rates will also be collected for reference data. In some cases, solid samples will need to be collected in the background area for comparative analyses of specific survey units. The same survey methodology and instruments used to collect the background data will be used to perform measurements within survey units.

Data collected in reference areas will be statistically evaluated using a graphical format, such as a frequency distribution chart. The purpose of the evaluation is to ensure that the data collected in the reference area is consistent with a normal distribution and that the variability of the background is not too high. Background variability may be considered high when differences in estimated mean concentration measured in potential reference areas are comparable to screening level DCGLs. NUREG-1505 (NRC, 1997b), Chapter 13, *Demonstrating Indistinguishability from Background*, provides detailed guidance for evaluating reference areas exhibiting high variability.

For example, here's the link to the 27 MB 1st section of the Parcel UC-3 Removal Action Completion Report (RACR):

http://www.envirostor.dtsc.ca.gov/regulators/deliverable_documents/3814468204/Hunters%20Point_Final%20Radiological%20Removal%20Action%20Completion%20Report%201of3_03.16.2012.pdf

Here is an excerpt from this report that discusses the background for Radon-226 for **Parcel UC-3, p. 3-7 of its Rad RACR**.

3.3 REFERENCE AREA

Reference area samples for the sanitary sewer and storm drain removal project were obtained in April 2006 in an area of the Building 813 parking lot in Parcel D-2. Building 813 was identified in the HRA as being impacted, but the parking lot area was not identified as being impacted, and is considered of like material to that encountered in the soils in survey units. Eighteen samples were collected systematically from this area for reference area purposes. All 18 samples were analyzed at the on-site laboratory by gamma spectroscopy. Ten percent of samples (two samples total) were also analyzed for ⁹⁰Sr at the on-site laboratory. The reference area samples provided a basis for net activity concentration. Background activity for ²²⁶Ra was determined to be 0.485 pCi/g, placing the release criterion at 1.485 pCi/g of ²²⁶Ra.

Similarly For Parcel G:

The investigation level for gamma radiation surveys was established at the reference area mean plus 3-sigma, where sigma is the standard deviation of the gamma readings in the reference or background area. Background activity for Ra-226 was determined to be 0.485 pCi/g, establishing the release limit at 1.485 pCi/g. The mean activity in the background reference area was established at 0.001 pCi/g for Pu-239 and 0.020 pCi/g for U-235. The other ROCs were assumed to have a mean reference area activity of zero.

Appendix A begins on p. 28 of this document:

http://www.envirostor.dtsc.ca.gov/regulators/deliverable_documents/7709416031/Parcel%20G%20Radiological%20Removal%20Action%20Completion%20Report%20Part%203_Hunters%20Point_12.02.2011.pdf

Parcel D-1, p. 7-44

The investigation level for gamma radiation surveys was established at the reference area mean plus 3-sigma, where sigma is the standard deviation of the gamma readings in the reference or background area. Background activity for Ra-226 was determined to be 0.485 pCi/g, establishing the release limit at 1.485 pCi/g. The mean activity in the background reference area was established at 0.001 pCi/g for Pu-239 and 0.020 pCi/g for U-235. The other ROCs were assumed to have a mean reference area activity of zero.

Final Survey Unit Project Reports Abstract, Rev. 3
Sanitary Sewer and Storm Drain Removal Project
Hunters Point Shipyard
DCN: EMAC-8823-0003-0100.R3
CTO No. 0003

July 7, 2011

This is referenced for Parcel G

1.1 PURPOSE

This Survey Unit Project Reports (SUPRs) Abstract was prepared to document work conducted under the final Base-wide Storm Drain and Sanitary Sewer Removal Work Plan (TtEC 2006) and final Base-wide Storm Drain and Sanitary Sewer Removal Work Plan – Revision 4 (TtEC 2010) (Work Plan) at Hunters Point Shipyard (HPS), San Francisco, California. This Abstract summarizes the scope, approach, and radiological surveys used during removal of the sanitary sewer and storm drains located within HPS prior to December 31, 2010. This Abstract will be applicable to all associated SUPRs and data sets prepared for regulatory review unless otherwise noted.

The previous version of this document (revision 2 to the final) was prepared under Contract No. N68711-98-D-5713, Contract Task Order (CTO) No. 0072. This document (revision 3 to the final) was prepared under Contract No. N62473-08-D-8823, CTO No. 0003.

The laboratory results for this SUPRA did not include Th-232

SUPRA Parcel C:

Final Survey Unit Project Reports Abstract for Parcel C
SS/SD Removal Containing NORM Conducted After March 1, 2013
Hunters Point Naval Shipyard
DCN: RMAC-0809-0012-0052
CTO No. 0012

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Geological and radiological analysis of soil types in Parcel C of HPNS indicate that large quantities

of NORM fill material were used to construct road base, as well as surround conduit lines. This NORM fill material is characterized by a sandy brown physical characteristic, as well as a radium-226 (^{226}Ra) and thorium-232 (^{232}Th) concentration in excess of 1 pCi/g, with an approximate one to one ratio in activity concentrations. A further description of the NORM fill material is contained

in Appendix A, "Geological Analysis of Elevated Concentrations of Naturally Occurring Radioactive Material in Hunters Point Naval Shipyard Parcel C Fill Material". Because this type of material naturally contains elevated concentrations of Ra-226 and Th-232 as compared to materials in the previous reference area used for SUPRs, an appropriate reference area within Parcel C is necessary to prevent the unnecessary disposal of NORM fill material as Low Level Radioactive Waste (LLRW).

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The investigation level for gamma surveys was established as the reference area mean + 3 σ where σ is the standard deviation of the gamma readings in the reference area, or the standard deviation of the gamma readings in the specific survey unit as recommended in Section 5.5.2.6 Multi-Agency

Radiation Survey and Site Investigation Manual (MARSSIM) (NUREG-1575; DoD et al. 2000), with prior approval from RASO. Note that in the case of excavated survey units surveyed on a Radiological Screening Yard (RSY) pad, a maximum of 18 investigative (or biased) soil samples were collected.

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3.3 REFERENCE AREA

Reference area samples for the sanitary sewer and storm drain removal project were obtained in December 2013 in an unimpacted area to the southeast of Lockwood Avenue adjacent to Parcel C.

Eighteen samples were collected systematically from this area for reference area purposes. All 18 samples were analyzed at the DoD ELAP accredited laboratory by gamma spectroscopy.

The reference area samples provided a basis for net activity concentration.

Background activity for ^{226}Ra , based on the mean of the greater of the reported activity or minimum detectable activity (MDA), measured by a minimum of a 21-day in-growth of the 609.31 keV gamma energy peak for bismuth-214 (^{214}Bi), was determined to be 1.057 pCi/g. This places the release criterion at 2.057 pCi/g of ^{226}Ra for final definitive data, as well as radiological remediation decisions based on application of a shortened in-growth period in conjunction with a correlated ^{214}Bi in-growth factor. Note that this value is used in each SUPR for background subtraction of ^{226}Ra for dose and risk modeling.

The reference area gamma spectroscopy results from the DoD ELAP accredited are provided in Attachment 2. A summary of the results is provided in Table 3-3.

3.4 ADDITIONAL REFERENCE AREA RADIOANALYTICAL DATA

Seven of the reference area soil samples were selected at random and analyzed for actinium-228 (Ac-228), lead-212 (Pb-212), thorium-234 (Th-234), lead-214 (Pb-214) and bismuth-214 (Bi-214)

using gamma spectroscopy analysis at the onsite DoD ELAP accredited laboratory for an extended

count time of eight hours to minimize activity concentration uncertainties. These same samples were also analyzed at the TestAmerica St. Louis DoD ELAP accredited laboratory using alpha spectroscopy for thorium-232 (Th-232), thorium-228 (Th-228), uranium-238 (U-238) uranium 233/234 (U-233/234) and thorium-230 (Th-230). This data was used to establish that the Th-232 natural decay series (Th-232 to Ac-228 to Th-228 to Pb-212 to Bi-212) and the U-238 natural decay series (U-238 to Th-234 to U-234 to Th-230 to Pb-214 and Bi-214) were in secular equilibrium (i.e., the activity concentrations for each radionuclide in the decay chain are essentially equivalent taking into account uncertainties of the analytical methods), and, therefore, the comparatively elevated activity concentrations of Ra-226 and Th-232 can logically be deduced to be from naturally occurring radioactive materials in the material, as opposed to radiological contamination as the result of HPNS operations within the past 100 years. The approximate 1:1 ratio of Th-232 to Ra-226 was also demonstrated. The alpha spectroscopy and gamma spectroscopy extended count time results are contained in Attachment 2. Furthermore, the radiological concentration of naturally occurring radioactive materials from the reference area samples are similar to those from a sample from the Colma Formation exposed in the cliffs at Fort Funston (Sample 04-FUNST-003), indicating that this material may have been imported for use as fill. Additional discussions concerning the geological similarities between the Colma Formation

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and the NORM fill material are contained in Appendix A. A summary of the results organized by the Th-232 and U-238 decay chains are provided in Tables 3-4 and 3-5, respectively.

As a further measure, the soil samples were also analyzed by alpha spectroscopy at the TestAmerica St. Louis DoD ELAP accredited laboratory for plutonium-239 (Pu-239) to ensure potential contamination due to nuclear weapons testing, as Cs-137 concentrations as determined by gamma spectroscopy did not indicate fission fragments above background concentration. All results indicated activities less than the method detection limit. The alpha spectroscopy results are contained in Attachment 2. A summary of the results is provided in Table 3-6.

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TABLE 3-3

NORM FIII Material Reference Area Soil Measurements (Definitive)

Sample No.	Date	Time	²⁴¹ Am			¹³⁷ Cs			⁶⁰ Co			Results (pCi/g)			²³² Th			²³⁸ U		
			MDA	2σ Total		MDA	2σ Total		MDA	2σ Total		MDA	2σ Total		MDA	2σ Total		MDA	2σ Total	
1	12/20/2013	10:25:00	-0.068	0.192	0.236	-0.013	0.028	0.035	0.001	0.025	0.031	1.105	0.046	0.129	1.538	0.076	0.202	0.108	0.193	0.050
2	12/20/2013	10:27:00	0.009	0.172	0.209	-0.017	0.029	0.037	0.014	0.017	0.023	1.175	0.056	0.147	1.922	0.039	0.236	0.234	0.149	0.197
3	12/20/2013	10:29:00	-0.021	0.214	0.261	0.016	0.016	0.022	-0.001	0.025	0.030	1.062	0.052	0.135	1.469	0.045	0.198	0.118	0.216	0.051
4	12/20/2013	10:30:00	0.116	0.180	0.224	-0.018	0.028	0.035	-0.005	0.025	0.030	1.060	0.053	0.133	1.467	0.074	0.178	0.128	0.201	0.061
5	12/20/2013	10:31:00	-0.006	0.216	0.262	-0.002	0.023	0.029	-0.001	0.025	0.031	0.983	0.050	0.128	1.378	0.085	0.204	0.128	0.202	0.055
6	12/20/2013	10:32:00	0.083	0.156	0.194	0.008	0.025	0.031	0.001	0.012	0.018	0.924	0.054	0.132	1.165	0.079	0.150	0.076	0.197	0.056
7	12/20/2013	10:33:00	0.090	0.177	0.214	-0.004	0.022	0.027	0.001	0.024	0.012	0.945	0.046	0.125	1.352	0.073	0.201	0.154	0.162	0.221
8	12/20/2013	10:34:00	-0.042	0.196	0.240	-0.010	0.025	0.031	0.011	0.018	0.020	1.074	0.058	0.142	1.310	0.073	0.172	0.181	0.171	0.216
9	12/20/2013	10:35:00	0.005	0.178	0.217	-0.008	0.026	0.033	0.007	0.022	0.028	0.867	0.053	0.127	1.408	0.027	0.200	0.037	0.192	0.042
10	12/20/2013	10:36:00	-0.109	0.227	0.280	0.006	0.026	0.032	-0.005	0.024	0.030	1.091	0.050	0.129	1.744	0.068	0.193	0.105	0.210	0.049
11	12/20/2013	10:37:00	-0.059	0.175	0.215	0.012	0.024	0.030	-0.005	0.024	0.030	1.112	0.044	0.124	1.804	0.075	0.165	0.135	0.193	0.048
12	12/20/2013	10:38:00	0.035	0.159	0.195	-0.006	0.026	0.032	-0.007	0.027	0.034	0.967	0.057	0.144	1.349	0.078	0.208	0.124	0.192	0.049
13	12/20/2013	10:39:00	0.100	0.202	0.251	-0.006	0.026	0.032	-0.002	0.027	0.003	1.053	0.054	0.133	1.456	0.098	0.185	0.100	0.171	0.046
14	12/20/2013	10:40:00	0.006	0.223	0.271	0.000	0.024	0.029	0.006	0.019	0.024	0.986	0.045	0.121	1.565	0.069	0.163	0.076	0.199	0.063
15	12/20/2013	10:41:00	0.000	0.206	0.250	0.010	0.025	0.032	0.004	0.027	0.022	0.966	0.048	0.130	1.445	0.061	0.203	0.114	0.226	0.048
16	12/20/2013	10:42:00	-0.049	0.200	0.245	0.007	0.026	0.032	-0.003	0.024	0.030	1.103	0.042	0.133	1.286	0.099	0.188	0.104	0.207	0.046
17	12/20/2013	10:43:00	0.041	0.172	0.211	-0.012	0.030	0.038	0.004	0.026	0.010	1.381	0.050	0.151	1.619	0.098	0.185	0.126	0.212	0.048
18	12/20/2013	10:44:00	-0.002	0.207	0.252	0.000	0.025	0.030	-0.010	0.024	0.031	1.177	0.053	0.140	1.469	0.080	0.181	0.123	0.197	0.049
mean			0.001			-0.002			0.001			1.057			1.489			0.121		
std dev			0.060			0.010			0.006			0.118			0.190			0.042		
median			0.000			-0.003			0.000			1.081			1.463			0.121		

Notes:

Information concerning flags associated with the on-site laboratory data can be found in Section 4.3.

Abbreviations and Acronyms:

¹³⁷Cs – cesium-137

MDA – minimum detectable activity

MDC – minimum detectable concentration

pCi/g – picocuries per gram

²²⁶Ra – radium-226

std dev – standard deviation

²³²Th – thorium-232

TABLE 3-4

NORM Fill Material – Thorium-232 Decay Series Results															
Sample ID	Th-232 Natural Decay Series (pCi/g)														
	Th-232 (alpha spec)			Ac-228 (gamma spec)			Th-228 (alpha spec)			Pb-212 (gamma spec)			Bi-212 (gamma spec)		
	Activity	Uncertainty	MDL	Activity	Uncertainty	MDA	Activity	Uncertainty	MDL	Activity	Uncertainty	MDA	Activity	Uncertainty	MDA
04A-FUNST-003	1.30	0.167	0.00722	1.616	0.05687	0.02464	1.25	0.166	0.0251	1.534	0.03878	0.01786	2.011	0.2322	0.1129
3	1.13	0.137	0.00497	1.490	0.06186	0.03019	1.12	0.139	0.0229	1.559	0.03622	0.01432	1.711	0.1940	0.09844
7	1.17	0.139	0.00477	1.204	0.06046	0.02768	1.23	0.146	0.0166	1.068	0.03456	0.01661	1.427	0.2145	0.1065
8	1.11	0.159	0.00866	1.228	0.05203	0.02821	0.96	0.151	0.0358	1.131	0.03573	0.01701	1.373	0.2063	0.106
9	1.10	0.134	0.00491	1.153	0.05416	0.03143	1.16	0.14	0.0163	1.173	0.03193	0.01397	1.271	0.1669	0.08902
12	1.21	0.143	0.00490	1.382	0.05992	0.02974	1.18	0.142	0.0184	1.272	0.03751	0.01737	1.540	0.2148	0.1087
15	1.17	0.140	0.00494	1.270	0.05452	0.02692	1.14	0.139	0.0171	1.296	0.03294	0.01326	1.466	0.2392	0.119
16	1.19	0.140	0.00355	1.365	0.06002	0.03013	1.24	0.146	0.0204	1.375	0.03458	0.01397	1.638	0.2258	0.1135

Abbreviations and Acronyms:

Ac-228– actinium-228
Bi-212 – bismuth-212
MDA – minimum detectable activity
MDL – method detection limit
Pb-212 – lead-212
pCi/g – picocuries per gram
Th-228 – thorium-228
Th-232 – thorium-232